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15 April 1955

MEMORANDUM FOR: THE RECORD

SUBJECT: Report of Test Results, P-101B, Communications System, Infrared

1. Time and Place of Tests: The tests were held from 5-7 April 1955 in the vicinity of [redacted] Exact sides are shown on the attached USGS map. (Attachment 1)

25X1

2. Attendance at Tests:

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3. Equipment Tested:

The equipments tested were the first four prototype IR communication units produced by [redacted] under Task I of RD-54. Serial numbers of the equipments were #1, 2, 3, and 4.

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The general characteristics of the equipment are:

a. Size: 7" x ^{12"}15" x ^{16"}18" complete when packed

b. Weight: 30 lbs.

c. Operating Life: 2 hours transmit at 32°F

d. Power Supply: Yardney Silvercell batteries. A charger is supplied for 110-220 volt 50-60 cps operation.

e. Beamwidth: Transmit - 1 1/4° x 1/4°
Receive - 1/3° x 1/3°

f. Visual Security: The visual security of the system is excellent. No trace of visible light is visible under the conditions mentioned below.

4. Accessory Equipment:

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The following accessory gear was used during the tests:

2 binoculars, U. S. Navy 7 x 50

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- 2 compasses, Corps of Engineers, 2" diameter,
(for night use)
- 2 sets USGS maps (1:62,500) of the area
- 4 flashlights, U. S. Army
- 1 set of drawing equipment including protractor,
triangle, engineer's ruler, pencils, masking tape
- 1 set photographic equipment including 2 Leica III F
35 mm cameras with 50 mm, 90 mm, 400 mm lenses

5. Test Procedures:

a. Signal Plans

Before leaving for the test sites a map overlay was prepared of a likely line-of-sight path. (Attachment 2). A check was made of line-of-sight by plotting the contour elevations between the selected stations. (Attachment 3) On the map overlay were marked the magnetic bearings of each station from the other and the line-of-sight range.

After examining the access roads to the stations in question a time was selected to start the contact. For example, it was decided in one case that the equipment would be set up by and put in operation on 1430 hours. It was also decided that failing contact by a definite time, in this case two hours, that no further attempts at communication would be made.

In summary, then, our signal plan contained the following data for each station operator.

- (1) A map of the area showing both stations
- (2) The magnetic bearings of each station from the other
- (3) The range in miles
- (4) The time to start operation
- (5) The time to give up operation if for some reason no contact is possible

In addition, definite procedures were set up for the search-find operation for both night and day use and were furnished to each operator.

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SECRET**b. Search-Find Procedures**

(1) **Night Procedure:** During night operation both operators, A and B, turned their equipments to transmit-find so that a beam was transmitted which was modulated by a 1000 cps tone. Then, using the IR viewers built into the equipments as receivers, both operators conducted a systematic sweep of the area wherein the other station was believed to be located. As soon as one operator observed a flash of light in his viewer caused by his being briefly in the beam of the transmitter at the opposite station, he centered his viewer reticle on the spot where the flash was observed. In this way contact can theoretically be established within a short time.

(2) **Daytime Procedure:** During the daytime different procedures were followed depending on the certainty with which the station locations were known.

In the most general procedure, operator B went on receive-find and made several sweeps in azimuth lasting 30 seconds each for each elevation setting. Simultaneously, A was on transmit-find and was making 3 second sweeps in a similar way. A went on receive-find for one sweep between changes in elevation. This procedure was continued until B was able to lock on A's transmitter and go to transmit-find to notify A that alignment was complete.

If B station location was known, for example, operator A aimed his transmitter directly at the spot and listened 15 seconds for each minute of transmit until contact was established by B using the above general technique.

6. Test Results:

A total of 13 tests were run at ranges from 4.0 to 13.3 miles. Descriptions of the conditions prevailing and results follows.

a. Test #1

- (1) Range 4.0 miles (Little Stony Man to road junction 983)
(Photos #1, 2, 3, 4)
- (2) Weather and Visibility: The visibility was about 25-30 miles with some haze. Temperature about 65°F. Sky overcast but bright. (Time 1430)
- (3) Time Required to Set Up Equipment
A: 10 minutes
B: 7 minutes

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- (4) Time Required for Search-Find Procedure
 - A: 20 minutes
 - B: 6 minutes (started 14 minutes after A)
- (5) Time Required to Pack Up Equipment
 - A: 5 minutes
- (6) Comments
 - (a) Both stations were easily located by use of field glasses and compasses. The compass bearings were very helpful.
 - (b) Good voice contact was established; voices were both intelligible and recognizable.
 - (c) All alignment adjustments in azimuth and elevation were made by hand using coarse adjustments. The scanning mechanism was not used.
 - (d) The viewer was used as an optical sight; it was not capable of seeing the transmitter beam.
 - (e) Some trouble was had with the chains on the tripod legs when on soft ground. The chains were disconnected and good results were obtained.

b. Test #2

- (1) Range 4.0 miles (Little Stony Man to road junction 983)
- (2) Weather and Visibility: The visibility was about the same as in Test #1. The time was 2115. The night was clear and starry with a moon sufficiently bright to read by. Some ground haze was noticeable as distant lights were observed to twinkle. Temperature was about 50° F.
- (3) Time Required to Set Up Equipment
 - A: 9 minutes
- (4) Time Required for Search-Find Procedure -
No contact was established after one hour.
- (5) Time Required to Pack Up Equipment
 - A: 8 minutes
- (6) Comments

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- (a) No contact was established. This was partially due to the #4 equipment which was optically disaligned at the time.
- (b) The viewer was not sufficiently sensitive to distinguish between the sky and mountain. The need for an auxiliary sighting device was pointed out. The reticle in the IR viewer was too hard to see in one of the equipments.

c. Test #3

- (1) Range 4.0 miles as in Test #2
- (2) Weather and Visibility: The sky was overcast, low clouds; visibility was fair (less than 10-15 miles). Some light rain showers were observed. Time 1200.
- (3) Time Required for Search-Find Procedure
 - A: 2 minutes
 - B: 3 minutes (started earlier than A)
- (4) Comments
 - (a) Good voice contact established as in Test #1. Some garbling was noticed at times, apparently due to the atmosphere although no correlation was observed between garbling and visibility.
 - (b) It was noted that all units except #4 operated perfectly. #4 was able to transmit or receive, but not both. This indicates disalignment.
 - (c) Units appear to operate well through some clouds and rain squalls.

d. Test #4

- (1) Range 6.1 miles (Little Stony Man to NW of Holmes School) (Photos #5, 6, 7)
- (2) Weather and Visibility: Same as in Test #3. Time 1315.
- (3) Time Required for Search-Find Procedure
 - A: 7 minutes
 - B: 5 minutes (started after A)

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(4) Comments

- (a) Good voice reception achieved. The signal levels were similar to those at 4 miles.

e. Test #5

- (1) Range 8.6 miles (Little Stony Man to road near junction 831) (Photos #7, 8, 9)
- (2) Weather and Visibility: The conditions were the same as during Test #3. Time 1515
- (3) Time Required to Set Up Equipment
A: 4 minutes each for two units
- (4) Time Required for Search-Find Procedure
A: 3 minutes
B: 3 minutes

(5) Comments

- (a) Good voice contact was established as before. A noticeable drop in signal level was observed.
- (b) Alignment became more critical.

f. Test #6

- (1) Range 11.4 miles (Little Stony Man to BM1850 on Massanutten Mtn. (Photos #7, 10, 11)
- (2) Weather and Visibility: The conditions were the same as in Test #3. Time 1645. During the contact a rain squall moved through the line-of-sight. Visible contact between stations was lost several minutes before losing voice contact.
- (3) Time Required for Search-Find Procedure
A: 3 minutes
B: 3 minutes

(4) Comments

- (a) Good voice contact was established and maintained except during worst of rain squall.
- (b) Alignment is more critical than at 8.6 miles.

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g. Test #7

- (1) Range 4.0 miles (Little Stony Man to road junction 983)
- (2) Weather and Visibility: The weather was good with scattered clouds and a bright moon. The visibility was good. Time 2045.
- (3) Time Required for Search-Find Procedure
 - A: 15 minutes
 - B: 15 minutes
- (4) Comments
 - (a) The transmitter beam appeared quite bright in the viewer when it was visible at all. Some trouble was had locating the narrow transmitter beam, however.
 - (b) Good voice contact established as before.

h. Test #8

- (1) Range 8.6 miles (Little Stony Man to road near junction 831)
- (2) Weather and Visibility: Conditions were the same as in Test #7. Time 2215
- (3) Time Required for Search-Find Procedure
 - A: 20 minutes (brief contact in 5 min. was broken)
 - B: 20 minutes
- (4) Comments
 - (a) Good voice contact established as before.
 - (b) Transmitter source still easily visible in the viewer when the transmitter is aligned.

i. Test #9

- (1) Range 11.4 miles (Little Stony Man to BM1850 on Massanutten Mtn.)
- (2) Weather and Visibility: Conditions were as in Test #8 Time 2310.

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- (3) Time Required for Search-Find Procedure
No contact was established in 30 minutes despite use of visible light signals.
- (4) Comments
 - (a) No indication of either transmitter beam was apparent in either viewer. Alignment on automobile headlights produced neither contact nor any visible sign of either transmitter beam in the viewers.

j. Test #10

- (1) Range 4.0 miles (Little Stony Man to road junction 983)
- (2) Weather and Visibility: The visibility was 25 or more miles. The sky was clear with scattered clouds. Windy. Time 1245.
- (3) Time Required for Alignment
The equipments were aligned in 1 minute using crude sighting notches filed into the top of the equipment.
- (4) Comments
It appears that under certain conditions during both day and night that iron gunsights or a reasonable facsimile can be very useful for alignment.

k. Test #11

- (1) Range 6.1 miles (Little Stony Man to NW of Holmes School)
- (2) Weather and Visibility: Same as Test #10.
- (3) Time Required for Alignment
The equipment was aligned using the crude notch sights in 2 minutes.
- (4) Comments
None

l. Test #12

- (1) Range 13.3 miles (Crescent Rock to BM1850 on the Massanutten Range (Photo #16))
- (2) Weather and Visibility: Same as Test #10. Time 1545 to 1628. Transient snow squalls.

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- (3) Time Required for Search-Find Procedure
35 minutes (due partially to unfamiliarity with position of Crescent Rock Station)
- (4) Comments
 - (a) During the contact a snow squall crossed the valley and passed through our line-of-sight. Visual contact was lost but voice contact was maintained.
 - (b) The signal strength at 13.3 miles was adequate. The increase in range showed itself mostly in making the alignment more critical.

m. Test #13

- (1) Range 6.1 miles (Little Stony man to NW of Holmes School)
- (2) Weather and Visibility: Conditions were the same as Test #10. Time 2015.
- (3) Time Required for Search-Find Procedure: 10 minutes
- (4) Comments
 - (a) Contact was finally established by using the viewer after it was found that the notch sights were not visible.
 - (b) An attempt was made to broaden the transmitter beam by pushing in the bellows. It was found that the direction of the beam changed so radically that a field experiment was not feasible regarding the effect of defocussing the beam.

7. Conclusions:

- a. The daytime range of the equipment is in excess of 13.3 miles.
- b. The nighttime range of the equipment is limited by alignment means to between 8.6 and 11.4 miles. Considerable improvement should be possible.
- c. The range at which the transmitter source may be detected by the viewer is 8.6 - 11.4 miles.

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d. The general performance of the electrical-optical parts of the equipment is excellent. Voice quality is sufficient to allow voices to be recognized. Intelligibility is excellent although there is some tendency for inexperienced operators to over or under modulate while transmitting.

e. The following improvements should be made if possible prior to construction of more equipments. *also Randle*

(1) Enlarge grip on handle *also* - it presently cuts into the hand.

(2) The scan mechanism tray must fit easily into the back cover with no binding.

(3) An air bleeder for bellows must be provided.

(4) Covers and snap fasteners:

(a) Relieve the strain of the fastener hooks against the lip of the channel by connecting opposite hooks together and not relying on the support of the edge of the channel.

(b) Decrease the number of fasteners - 3 per long side
- 2 per short side

(c) Decrease the depth of the "O" ring well compared to "O" ring diameter.

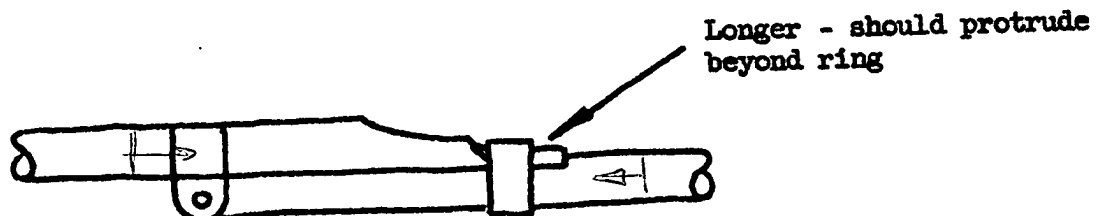
(5) Eliminate fine elevation adjustment rod and mounts.

(6) Eliminate the sweep-find mechanism.

(7) Battery Charger: Arrange the battery charger cord so that it is accessible from the rear of the equipment without removing the front cover.

(8) Tripod Legs:

(a) At the center hinge increase the length of the portion over which sliding ring fits.



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(b) Make sure all the ball-socket leg joints are tight - some came loose.

(c) Improve the attachment of sockets to cover.

(d) Arrange to have the legs held in place when packed.

(9) Infra Red Viewer:

(a) Improve the viewer by eliminating the lack of sharpness in the image.

(b) Make the reticle more easily visible at night.

(c) Eliminate as much parallax as possible.

(d) Add a rubber boot (light shield) to the viewer eyepiece.

(10) Yoke:

(a) Reduce all but the vertical pieces of the yoke to $2/3$ of their present thickness. Use lightening holes to reduce the weight further.

(b) Arrange spring detents on the side pieces of the yoke so that they will stand upright.

(c) Arrange the slots in the side pieces of the yoke so that the studs and wing nut on the equipment line up naturally when the equipment is held by the handle.

(d) Eliminate one of the two wing nuts presently used. Try to make the other protrude less than at present.

(e) Graduate the azimuth and elevation scales.

(11) Improve the accessibility of the PbS cell alignment adjustment screws.

(12) Provide covers for the windows in the front cover.

(13) Consider the possibility of adding a metallic sighting scheme to the present equipment.

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(14) Add a standard phone output jack.





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Attachments:
Maps and Photos (to original only)

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Distribution:

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1 - 
1 - Office of Commo
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